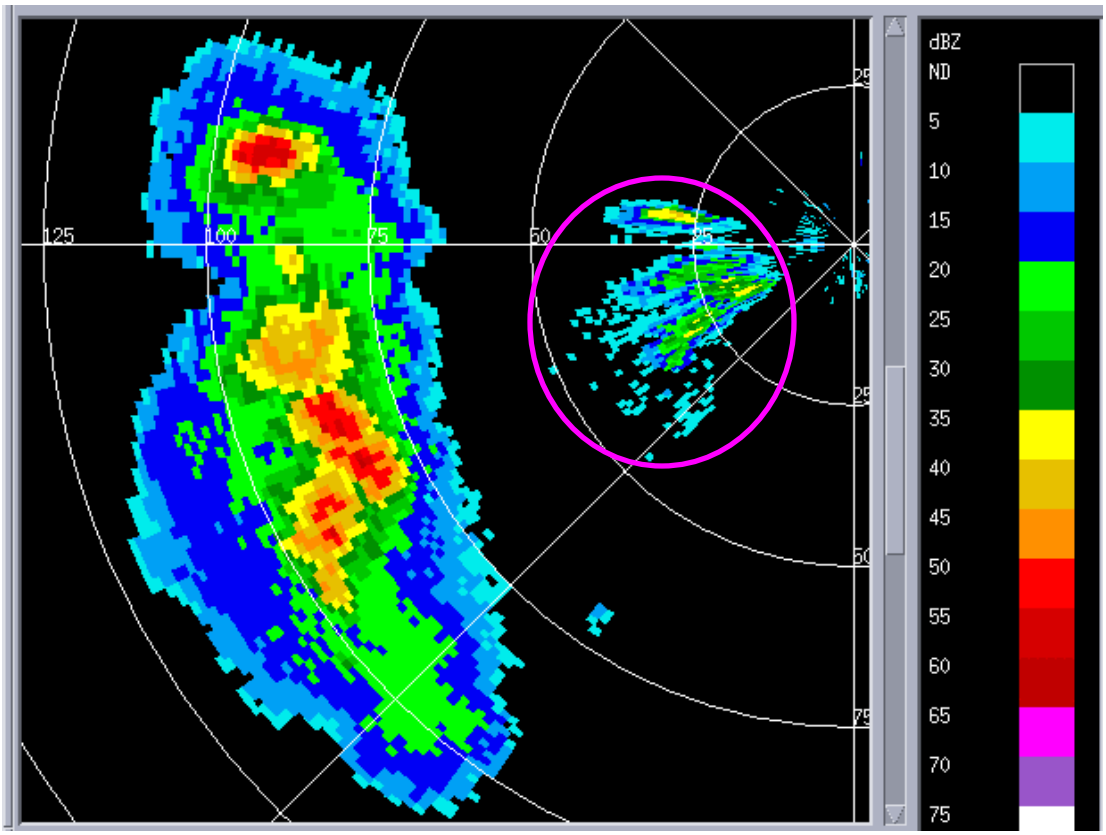
Ghost Echoes
Range Unfolding Algorithm Failure in Batch Mode

The ROC, with help from the NWS Forecast Office in Lubbock, TX, RSIS, and DBZ and Lee staff, has completed an investigation into the failure of the WSR-88D's range unfolding algorithm. The failure produced spurious echoes which came to be known as "Ghost Echoes." Ghost echoes are rare, but when they exist, they could impact operations. An operator could mistake ghost echoes for real echoes in base and composite reflectivity products, and ghost echoes could contaminate algorithm output such as precipitation estimates.

What is a ghost echo? A ghost echo is when a real echo is also erroneously displayed at a lesser range along the same azimuth. Below is an example of typical ghost echoes in a KDDC 2.4 degree base reflectivity product. The ghost echoes are circled in purple; the real echoes are the thunderstorms at longer ranges along the same azimuths. (The range rings are in increments of 25 nmi, and the radar is on the right side of the display.) Notice the ghost echoes have reduced reflectivity, but the peak reflectivities in the ghost echoes are at the same azimuths as the peak reflectivities in the real thunderstorms. Most of the ghost echoes observed on operational systems have resulted from tall thunderstorms at a range of about 100 nmi. The ghost echoes are most noticeable on the base reflectivity products; however, they can sometimes also be seen in the composite reflectivity product.



When do ghost echoes occur? Ghost echoes occur under the following predictable circumstances:

- During batch mode wave form elevation scans (or 1.65 to 6.4 degrees for precipitation mode VCPs).
- When and where there is a user-defined (i.e. “all bins”) clutter suppression region used in the batch mode (or high segment, elevation scans between 1.65 and 6.4 degrees in precipitation mode VCPs). It does not occur when and where bypass map clutter filtering or no clutter filtering is being used.
- When there is a real echo beyond the velocity unambiguous range of significant reflectivity.
- Can occur with any VCP.
- Can occur with any recent RPG build.

How to get rid of ghost echoes. WSR-88D sites should always use clutter suppression judiciously. Doing so will greatly reduce the chance of having ghost echoes. In particular, sites should only apply user-defined clutter suppression regions and/or high suppression in specific areas and at necessary times. Not only will this minimize the chance for ghost echoes, it will improve data quality. If the use of high suppression is required, especially in the high segment, there may be other site-specific problems that need to be investigated.

Since ghost echoes can only occur when and where there is at least one user-defined clutter suppression region in the high segment, sites can eliminate the possibility of ghost echoes completely by only using the bypass map in the high segment. Detailed procedures to eliminate the possibility of ghost echoes are included in the next section.

Detailed procedures to eliminate ghost echoes.
Following the procedures below will eliminate the possibility of ghost echoes by using the “Bypass Map” for high segment clutter suppression.

1) At the HCI GUI, select the "Clutter Regions" button on the right hand side.

2) In the new window, click the lock button in the upper right hand corner. In the small password pop-up window, select “URC”, type in the password, and type <Enter>.

3) Select the “File” button in the upper left of the window, and a small pop-up window will appear.

    a) On the small pop-up window, select a file by double clicking on the row with the desired file label. (All of the files should be modified, except the “Default” which cannot be modified. Repeat steps 3a-3e to modify each file.)

    b) On the large window, below the display, select the button for the "High" Segment. When selected, the button will be white, and there will be a thin red box around the button and “High”.

c) Ensure there is only one line of data in the lower part of the screen. If there are several, delete all except line 1. To delete a line, select the line, and select the "Delete" button.

d) Line 1 should read:

0 to 360, 1-275, Bypass Map, Dopp Chan=Medium, Surv Chan=Medium

If the numbers are incorrect, double click inside the block and change them. To change the "Select Code", "Dopl Chan", or "Surv Chan", click in the colored block below the title until it reads as above.

e) Save your changes by selecting "Save" in the small pop-up window, and selecting "Yes" on the new pop-up window.

f) Repeat steps 3a – 3e for each file the site routinely uses.

g) If you want to insure these files will always be available, select "Update Baseline", and select "Yes" on the new pop-up window. Then save to floppy using the save_adapt_floppy command, as is normally accomplished after a software load.

For assistance in making the suggested changes, or if you have questions, please contact the NEXRAD Hotline at 1-800-643-3363.